US009169075B2

(12) **United States Patent**
Allen et al.

(10) **Patent No.: US 9,169,075 B2**
(45) **Date of Patent: Oct. 27, 2015**

(54) **CONVEYOR HAVING DUAL-DIRECTION DRIVE**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **14/326,643**

(22) Filed: **Jul. 9, 2014**

(65) **Prior Publication Data**

US 2014/0318930 A1 Oct. 30, 2014

Related U.S. Application Data

(62) Division of application No. 13/598,830, filed on Aug. 30, 2012, now Pat. No. 8,807,323.

(60) Provisional application No. 61/648,204, filed on May 17, 2012.

(51) **Int. Cl.**

B65G 23/00	(2006.01)
B65G 23/32	(2006.01)
B65G 23/10	(2006.01)
B65G 21/12	(2006.01)

(52) **U.S. Cl.**

CPC ***B65G 23/32*** (2013.01); ***B65G 23/10*** (2013.01); *B65G 21/12* (2013.01)

(58) **Field of Classification Search**

CPC B65G 23/06; B65G 23/10; B65G 23/12
USPC 198/860.1, 861.1, 369.1, 369.5, 463.3, 198/832, 835, 832.1
See application file for complete search history.

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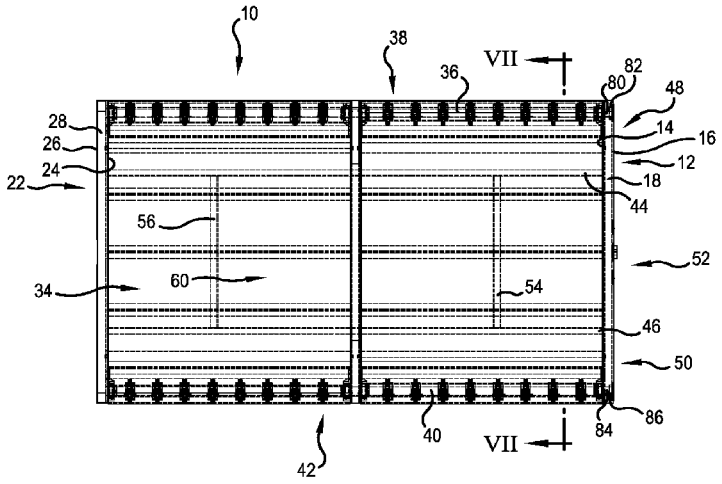
(57) **ABSTRACT**

A conveyor includes a frame having first and second spaced frame elements having outer sides and facing inner sides, first and second drive rollers between the first and second frame elements, a flexible belt mounted on the first and second drive rollers, first and second drive wheels connected to the first and second drive rollers, and a drive operably connected to the first and second drive wheels and configured to drive the belt in a first direction and in a second direction opposite the first direction.

20 Claims, 9 Drawing Sheets



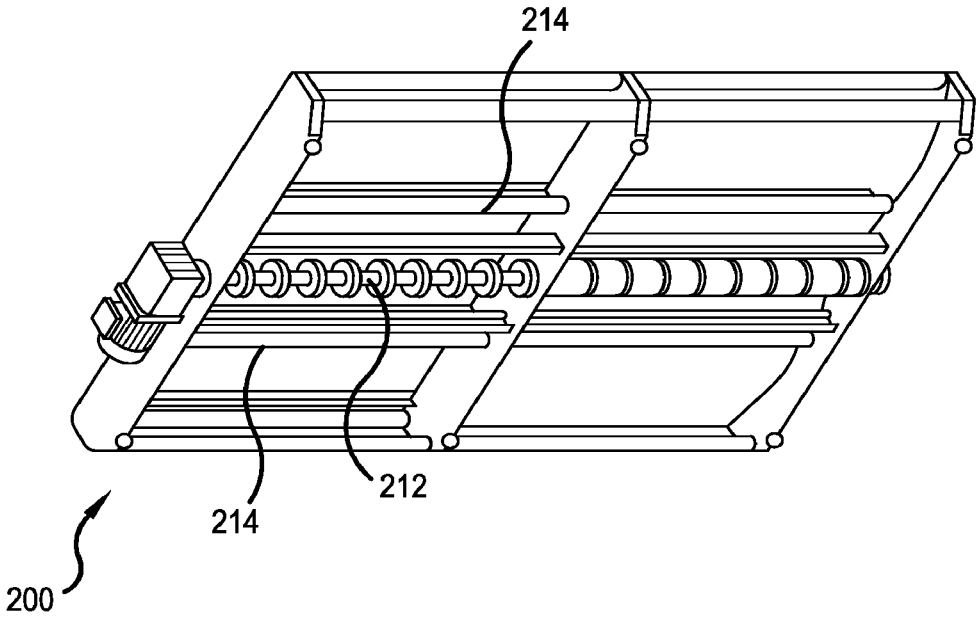


FIG.1
CONVENTIONAL ART

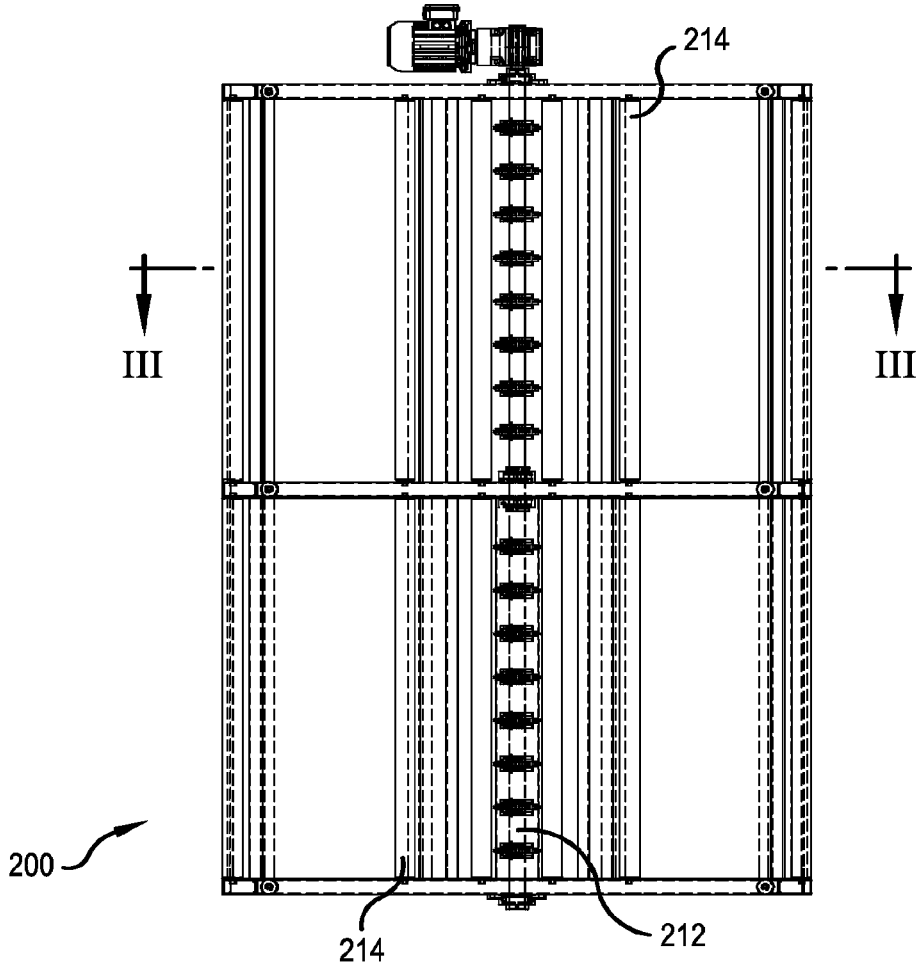


FIG.2
CONVENTIONAL ART

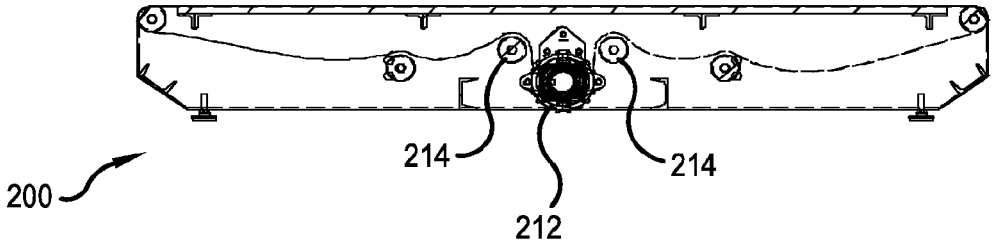
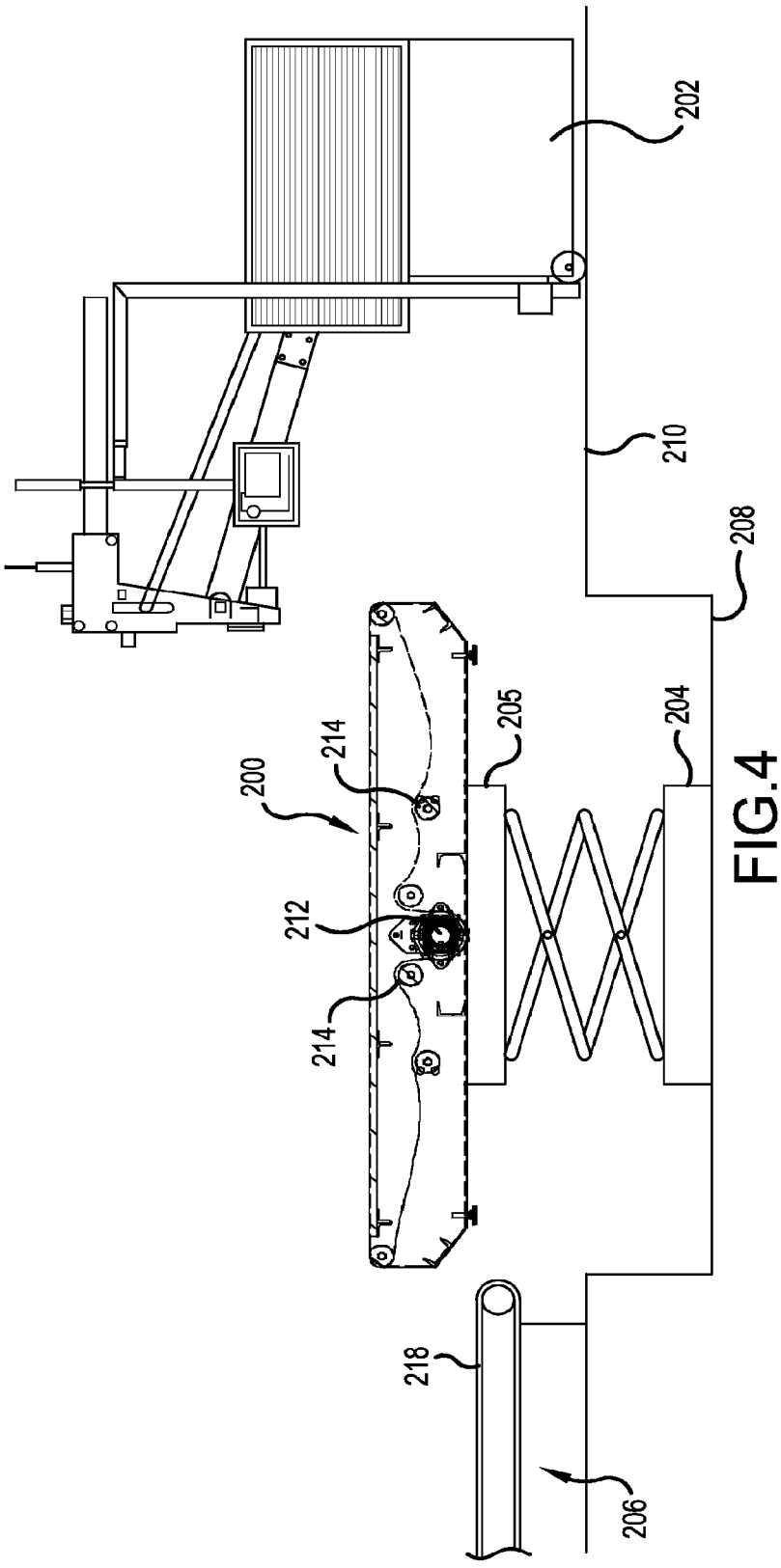


FIG.3
CONVENTIONAL ART



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CONVENTIONAL ART

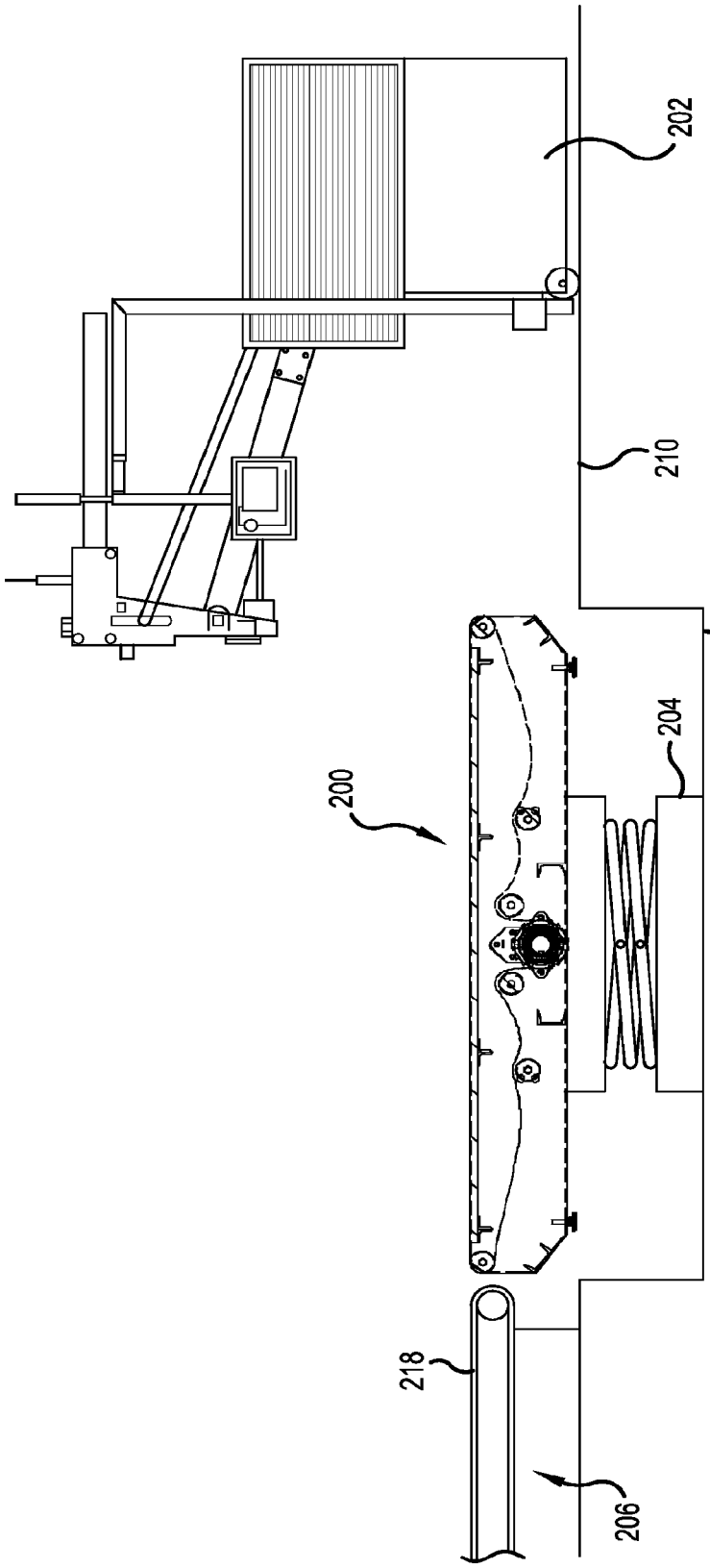

FIG.5
CONVENTIONAL ART

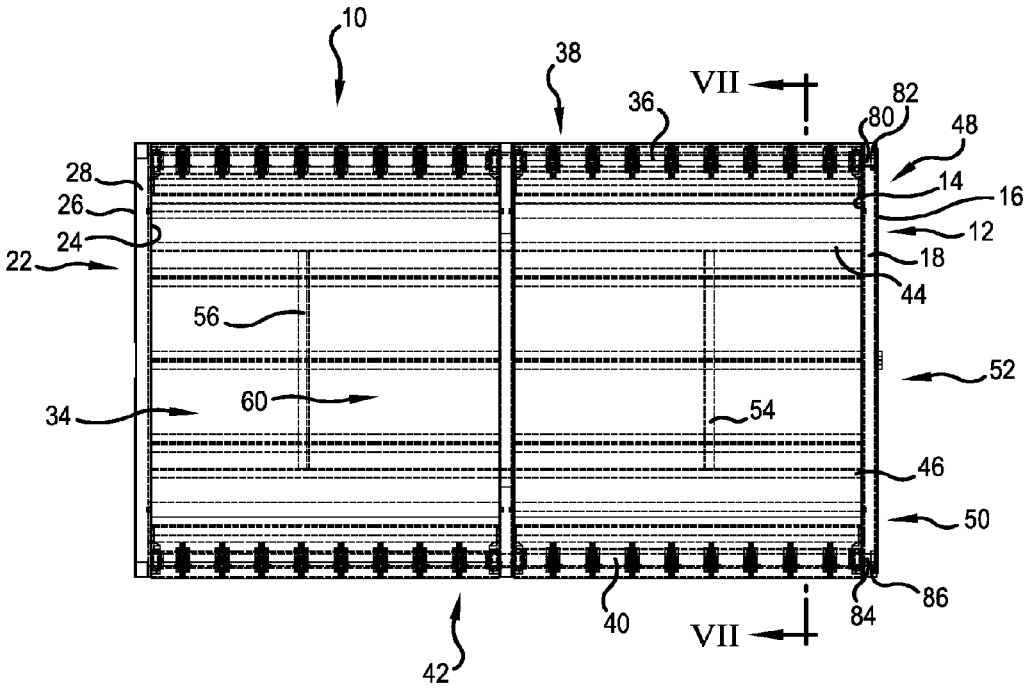

FIG.6

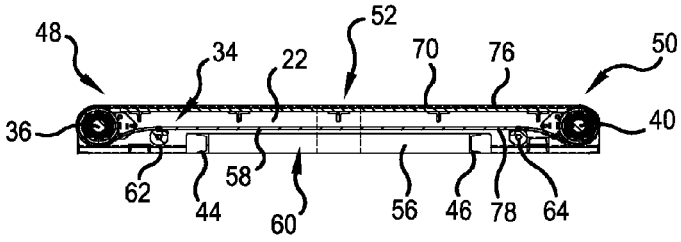

FIG.7

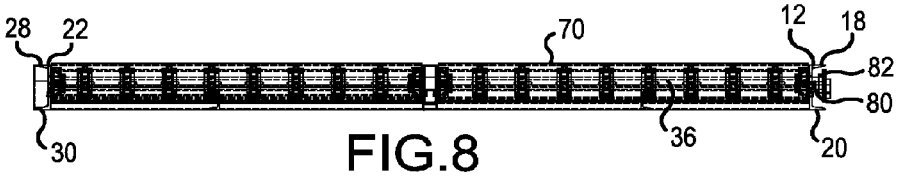

FIG.8

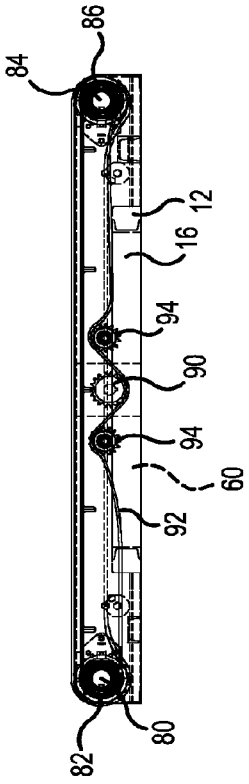
86
84
12
16
94
90
94
60
92
80
82

FIG.9

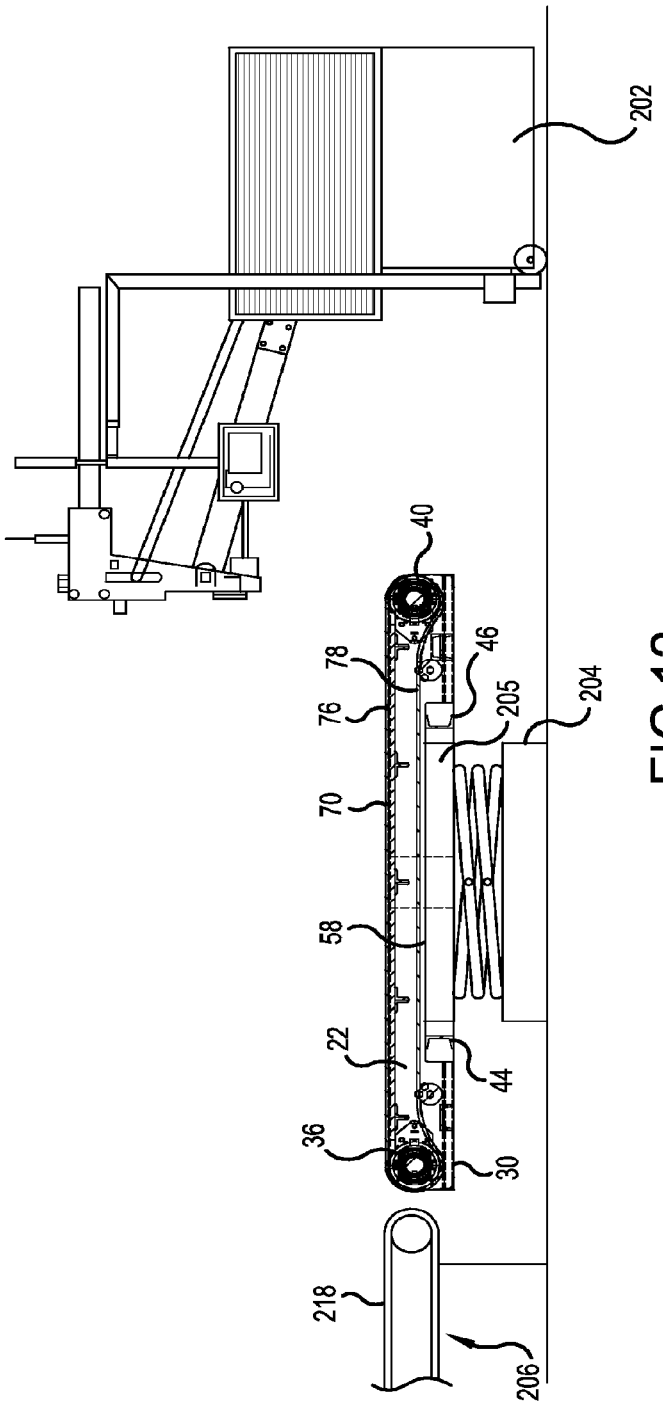
202
40
78
46
76
205
204
70
58
22
44
36
30
218
206

FIG.12

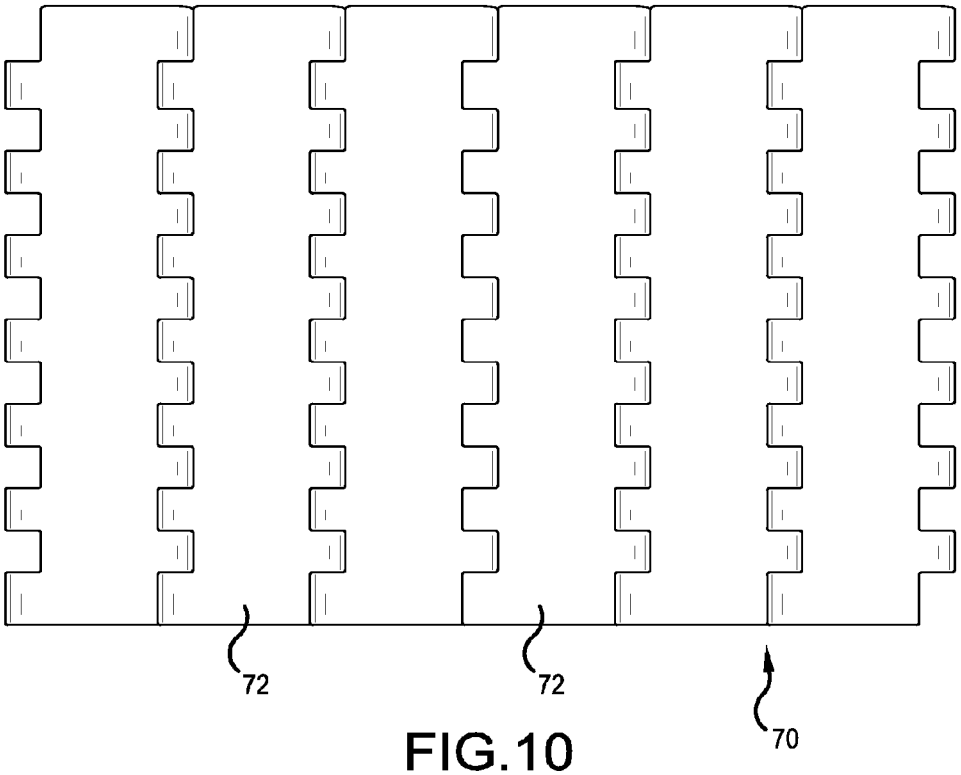

FIG.10

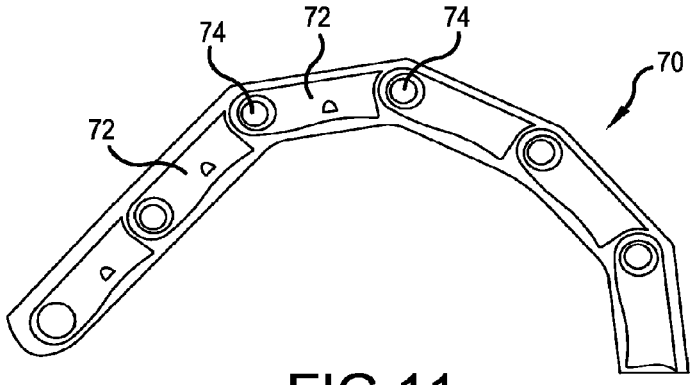

FIG.11

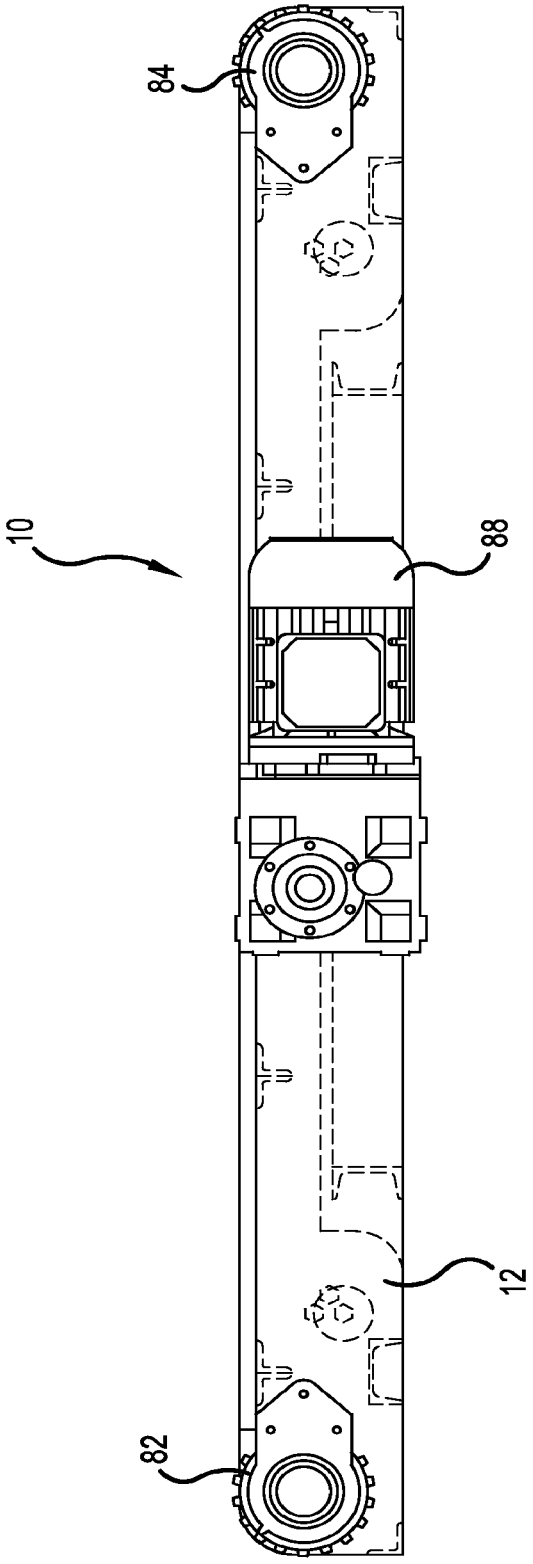

FIG.13

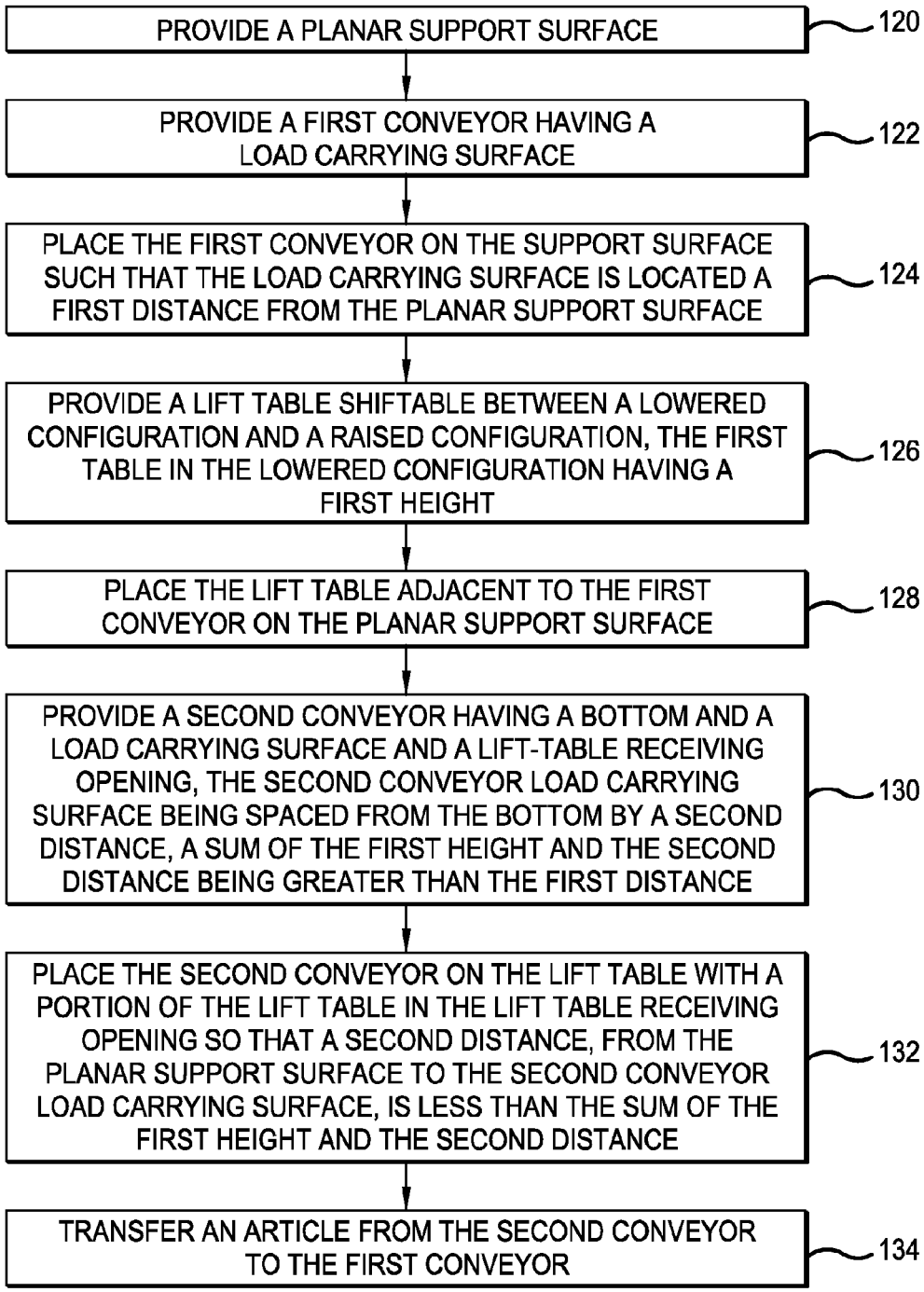
PROVIDE A PLANAR SUPPORT SURFACE
120
PROVIDE A FIRST CONVEYOR HAVING A LOAD CARRYING SURFACE
122
PLACE THE FIRST CONVEYOR ON THE SUPPORT SURFACE SUCH THAT THE LOAD CARRYING SURFACE IS LOCATED A FIRST DISTANCE FROM THE PLANAR SUPPORT SURFACE
124
PROVIDE A LIFT TABLE SHIFTABLE BETWEEN A LOWERED CONFIGURATION AND A RAISED CONFIGURATION, THE FIRST TABLE IN THE LOWERED CONFIGURATION HAVING A FIRST HEIGHT
126
PLACE THE LIFT TABLE ADJACENT TO THE FIRST CONVEYOR ON THE PLANAR SUPPORT SURFACE
128
PROVIDE A SECOND CONVEYOR HAVING A BOTTOM AND A LOAD CARRYING SURFACE AND A LIFT-TABLE RECEIVING OPENING, THE SECOND CONVEYOR LOAD CARRYING SURFACE BEING SPACED FROM THE BOTTOM BY A SECOND DISTANCE, A SUM OF THE FIRST HEIGHT AND THE SECOND DISTANCE BEING GREATER THAN THE FIRST DISTANCE
130
PLACE THE SECOND CONVEYOR ON THE LIFT TABLE WITH A PORTION OF THE LIFT TABLE IN THE LIFT TABLE RECEIVING OPENING SO THAT A SECOND DISTANCE, FROM THE PLANAR SUPPORT SURFACE TO THE SECOND CONVEYOR LOAD CARRYING SURFACE, IS LESS THAN THE SUM OF THE FIRST HEIGHT AND THE SECOND DISTANCE
132
TRANSFER AN ARTICLE FROM THE SECOND CONVEYOR TO THE FIRST CONVEYOR
134

FIG.14

CONVEYOR HAVING DUAL-DIRECTION DRIVE

CROSS-REFERENCE TO RELATED APPLICATIONS

The present application is a continuation of U.S. patent application Ser. No. 13/598,830, filed Aug. 30, 2012, which application claims the benefit of U.S. Provisional Patent Application No. 61/648,204, filed May 17, 2012, and the entire contents of these applications are hereby incorporated by reference.

FIELD OF TECHNOLOGY

The present invention is directed toward a conveyor that is mountable on a support structure such as a lift table and toward a method of using same, and, more specifically, toward a conveyor having a bottom opening configured to receive part of a lift table to reduce a combined height of the conveyor and lift table when the conveyor is mounted on the lift table and toward a method of using same.

BACKGROUND

Conventional conveyors, such as conveyor **200** illustrated in FIGS. **1-3**, are often constructed to have an upper conveyor belt surface that is located 12 inches above the floor or ground or other surface on which the conveyor **200** is mounted. This standard height makes it easier for conveyors to be integrated into existing production lines, many other elements of which are designed to work with a 12 inch conveyor height. Conveyors having belt surfaces located at greater heights can be provided by mounting a standard-height conveyor on a platform. However, in order to accommodate a belt return and associated tensioning rollers **214** and the conveyor drive shaft **212**, it is difficult to make conveyors that are significantly shorter than the standard 12 inch height.

Various known stacking devices **202** are designed to form stacks of material on a conveyor that is mounted on a lift table. A lift table **204** having a platform **205** supporting the conveyor **200** is illustrated in FIGS. **4** and **5**. A stacking process begins with the lift table **204** in a raised position (FIG. **4**) so that items exiting the stacker **202** fall a predetermined distance onto the conveyor **200** and form a stack (not illustrated). As the stack increases in height, the lift table **204** lowers the stack to maintain the predetermined distance between the discharge end of the stacker **202** and the top of the stack. When the stack has reached a desired height, the lift table **204** is operated to bring the top of the conveyor **200** to the standard 12 inch height so that the stack can be transferred onto an adjacent conveyor **206**.

As previously noted, the adjacent conveyor **206** will generally have a load carrying surface **218** located 12 inches above the floor. However, given that the lift table **204** has a minimum height of 8 to 12 inches from its bottom to the top of the platform **205**, and that it is difficult to make a conveyor **200** having a height less than 12 inches, the lift table **204** cannot lower a conventional conveyor **200** to the 12-inch height necessary for transferring a stack to the adjacent conveyor **206**. Therefore, in conventional facilities using stackers **202** and conveyors **200** mounted on lift tables **204**, a pit **208** is often dug in the floor **210** next to the stacker **202** so that the lift table **204** can be mounted in the pit **208**. This allows the lift table **204** to lower the conveyor **200** close to, even with, or beneath the level of the floor **210** as necessary to bring the top surface of the conveyor **200** to the 12-inch height and align it with the load carrying surface **218** of the adjacent conveyor **206**.

Digging a pit in a plant floor is undesirable for many reasons. First, there is an expense involved with digging and lining the pit and, in some cases, sealing the pit against water leakage. Moreover, after the pit is dug, any change in the layout of the manufacturing or processing line must either work around the location of the pit, or the pit must be filled in and a new pit dug in a new location. This reduces the flexibility of the line an increases the cost of any changes. If the pit is significantly larger than the lift table to be mounted therein, the pit may also pose a safety hazard and require appropriate marking, guards, etc. Alternately, raising the stacking device and all other equipment to a non-standard height of 20 inches, for example, would be cost prohibitive. It would therefore be desirable to provide a conveyor that can be used with a lift table and lowered to a 12 inch height without the use of a pit.

SUMMARY

These and other problems are addressed by embodiments of the present invention, a first aspect of which comprises a conveyor having a frame with first and second spaced frame elements having outer sides and facing inner sides. First and second drive rollers are mounted between the first and second frame elements, and a flexible belt is mounted on the first and second drive rollers. First and second drive wheels are connected to the first and second drive rollers, and a drive is operably connected to the first and second drive wheels and configured to drive the belt in a first direction and in a second direction opposite the first direction.

Another aspect of the invention comprises a conveyor having a frame with first and second spaced frame elements each having a top, a bottom, an outer side and an inner side. The inner side of the first frame element faces the inner side of the second frame element, and the conveyor includes first and second drive rollers, each having a diameter, between the first and second frame elements. A flexible belt is mounted between the first and second drive rollers and has a load bearing portion and a return portion, and the return portion extends between the inner sides of the first and second frame elements. The conveyor further comprises a first end portion including the first drive roller, a second end portion including the second drive roller and a central portion including a midpoint between the first drive roller and the second drive roller. The central portion of the conveyor includes a lift-table receiving space between the first drive roller and the second drive roller and between the first frame element and the second frame element, and the return portion of the belt extends between the load bearing portion and the lift-table-receiving space.

A further aspect of the invention comprises a conveyor having a frame with first and second spaced frame elements having outer sides and facing inner sides, first and second drive rollers between the first and second frame elements, a flexible belt mounted on the first and second drive rollers, and drive means for driving the first drive roller in a first direction and for driving the second drive roller in a second direction opposite said first direction.

Yet another aspect of the invention comprises a method of transferring articles that includes providing a planar support surface, providing a first conveyor having a load carrying surface, and placing the first conveyor on the support surface such that the load carrying surface is located a first distance from the planar support surface. The method also includes

providing a lift table shiftable between a lowered configuration and a raised configuration, where the lift table in the lowered configuration has a first height, and placing the lift table adjacent to the first conveyor on the planar support surface. The method further includes providing a second conveyor having a bottom and a load carrying surface and a lift-table receiving opening, the second conveyor load carrying surface being spaced from the bottom by a second distance, where a sum of the first height and the second distance is greater than the first distance, and placing the second conveyor on the lift table with a portion of the lift table in the lift-table-receiving opening so that a second height, from the planar support surface to the second conveyor load carrying surface, is less than the sum of the first height and the second distance. The method also includes transferring an article from the second conveyor to the first conveyor.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other aspects and features of embodiments of the present invention will be better understood after a reading of the following detailed description together with the attached drawings wherein:

FIG. **1** is a perspective view of the bottom of a conventional conveyor.

FIG. **2** is a bottom plan view of the conveyor of FIG. **1**.

FIG. **3** is sectional elevational view taken in the direction of line III-III in FIG. **2**.

FIG. **4** is a side elevational view of a system including a lift table in a raised position mounted in a pit and supporting the conveyor of FIG. **1**.

FIG. **5** is a side elevational view of the system of FIG. **4** showing the lift table in a lowered position.

FIG. **6** is a bottom plan view of a conveyor according to an embodiment of the present invention.

FIG. **7** is a sectional elevational view taken in the direction of line VII-VII in FIG. **6**.

FIG. **8** is an end elevational view of the conveyor of FIG. **6**.

FIG. **9** is a side elevational view of the conveyor of FIG. **6**.

FIG. **10** is a top plan view of a section of flexible belt for the conveyor of FIG. **6**.

FIG. **11** is a side elevational view of the belt of FIG. **10** in a curved configuration.

FIG. **12** is a side elevational view of a system including the conveyor of FIG. **6** mounted on a lift table.

FIG. **13** is a side elevational view of the conveyor of FIG. **6** showing the location of a motor.

FIG. **14** is a flow chart illustrating a method according to an embodiment of the present invention.

DETAILED DESCRIPTION

Referring now to the drawings, wherein the showing are for illustrating presently preferred embodiments of the invention only and not for the purpose of limiting same, FIG. **6** shows a conveyor **10** according to an embodiment of the present invention. Conveyor **10** includes a first frame element **12** having an inner side **14**, an outer side **16**, a top **18** and a bottom **20**, and a second frame element **22** parallel to and spaced from the first frame element **12**. The second frame element **22** includes an inner side **24** facing the inner side **14** of the first frame element, an outer side **26**, a top **28** and a bottom **30**. The bottom **20** of the first frame element **12** (FIG. **8**) and the bottom **30** of the second frame element **22** both lie in a common plane (not specifically illustrated) and form the bottom of the conveyor **10**. The volume bounded by the inner sides **14**, **24** of the first and second frame elements **12**, **22** and the common plane in which the bottoms **20**, **30** of the first and second frame elements **14**, **22** lie define a conveyor interior **34**.

A first drive roller **36** is connected between the first frame element **12** and the second frame element **18** at a first end **38** of the conveyor **10**, and a second drive roller **40** is connected between the first and second frame elements **12**, **14** at the second end **42** of the conveyor **10**. The conveyor interior **34** includes a first transverse support **44** and a second transverse support **46** connected between the first and second frame elements **12**, **22** and parallel to the first and second drive rollers **36**, **40**. The portion of the conveyor **10** between the first transverse support **44** and the first end **38** of the conveyor **10**, which includes the first drive roller **36**, may be referred to herein as the first end portion **48** of the conveyor **10**, the portion of the conveyor **10** between the second transverse support **46** and the second end **42** of the conveyor **10** may be referred to herein as the second end portion **50** of the conveyor **10**, and the portion of the conveyor **10** from the first transverse support **44** and the second transverse support **46** may be referred to as the central portion **52** of the conveyor **10**. A first longitudinal brace **54** and a second longitudinal brace **56** connect the first and second transverse supports **44**, **46** at locations inward of the first and second frame elements **12**, **22**, and a plate **58** (FIG. **7**) is connected to the first and second transverse supports **44**, **46** and first and second longitudinal braces **54**, **56** and defines therewith a lift-table-receiving space **60** within the conveyor interior **34**. A first tensioning roller **62** is connected between the first frame element **12** and the second frame element **22** in the first end portion **48** of the conveyor interior **34**, and a second tensioning roller **64** is connected between the first frame element **12** and the second frame element **22** in the second end portion **50** of the conveyor interior **34**.

A flexible belt **70**, a segment of which is illustrated by itself in FIGS. **10** and **11**, comprises a series interconnected rigid plastic elements **72** jointed by hinge pins **74**. A belt formed of a reinforced polymer material and/or a fabric (not illustrated) or any other conventional, flexible, belt, could also be used. The flexible belt **70** is mounted on the first and second driver rollers **36**, **40**, and includes a load carrying portion **76** near the tops **18**, **28** of the first and second frame elements **12**, **22** and a return portion **78** that runs through the interior **34** of the conveyor **10**. The first and second tensioning rollers **62**, **64** push the return portion **78** of the belt **70** toward the load carrying portion **76** and hold the return portion **78** of the belt **70** between the plate **58** and the load carrying portion **76** of the belt **70** in the central portion **52** of the conveyor interior **34**. The positions of the first and second tensioning rollers **62**, **64** and/or the force they exert on the return portion **78** of the belt **70** are adjustable to maintain a desired tension on the belt **70**.

With reference to FIGS. **6** and **8**, an end portion **80** of the first drive roller **36** projects through the first frame element **12** in the first end portion **48** of the conveyor **10** and has a first drive wheel **82**, which may comprise a sprocket **82**, mounted thereon; similarly, an end portion **84** of the second drive roller **40** projects through the first frame element **12** in the second end portion **50** of the conveyor **10** and has a second drive wheel **86**, which may comprise a sprocket **86**, mounted thereon. A drive **88**, illustrated in FIG. **13**, is mounted on the outer side **16** of the first frame element **12**, and includes a drive sprocket **90** that is turned by the drive **88** and which can be seen in FIG. **9** in which the drive **88** has been removed for illustration purposes. A drive chain **92** connects the sprocket **90** of the drive **88** to the first drive sprocket **82** and the second drive sprocket **86**, and tensioning sprockets **94** are adjustable to maintain a desired tension on the drive chain **92**. A belt

drive (not illustrated) could also be used with flanged drive wheels (not illustrated) configured to guide and retain the belt. Mounting the drive chain **92** and the first and second drive sprockets **82**, **86** on the outer side **16** of the first frame element **12** increases the space beneath the flexible belt and provides room for the lift-table-receiving space **60** in the conveyor interior **34**. However, it would also be possible to mount the first and second drive sprockets **82**, **86** on the inner side **14** of the first frame element if sufficient space is provided for these elements between the belt **70** and the first frame element **12**.

The drive shaft **212** and associated tensioning rollers **214** of conventional conveyors are centrally located on the bottom of the conveyor in order to allow the conveyor to be driven in two directions. If the drive shaft **212** were located at one end of the conveyor, it would be possible to drive the conveyor in only one direction by pulling the conveyor belt along the top of the conveyor toward the drive shaft. Conventional conveyor belts are flexible, and a flexible belt cannot be driven by pushing on the belt. Thus, it is generally considered necessary to provide a centrally disposed drive shaft to allow the conveyor to be driven in two directions. Indeed, conveyor manufacturers are sometimes reluctant to move drive shafts even slightly off center on the ground that this may increase wear and lead to premature failure of the belt and/or drive components. Using such a conventional system, it is not possible to provide sufficient space beneath the conveyor to accommodate a lift table and to drive the conveyor in two directions.

By providing first and second drive rollers **36**, **40** at either end of the conveyor **10**, and equipping them with first and second drive sprockets **80**, **82**, on the outer side **16** of the first frame element **12**, rather than using a centrally mounted drive shaft as in the conventional art, a conveyor is constructed with a lift-table-receiving space **60** in the conveyor interior **34**, which is not possible with a conventional design. Because both the first and second drive rollers **36**, **40** are connected to the drive **88**, the flexible belt **70** can be driven in both directions. While this arrangement is more expensive than the design of a conventional conveyor having a central drive shaft, it is less expensive than the cost of a conventional conveyor and the labor involved in constructing a pit and thus reduces overall costs and allows for greater flexibility in the positioning of equipment.

With reference to FIG. **12**, the conveyor **10** is mounted on the lift table **204** with the platform **205** of the lift table **204** inside the lift-table-receiving space **60** and the plate **58** resting on the platform **205**. Preferably, the locations of the first and second transverse supports **44**, **46** and the first and second longitudinal braces **54**, **56** are selected to define a lift-table-receiving opening **60** that is approximately the same size as the lift table platform **205** to securely hold the conveyor on the lift table platform **205**. The adjacent conveyor **206** has a load carrying surface **218** that is located a first distance above floor **210**, generally 12 inches, and the lift table **204** has a first height from the floor **210** to the top of platform **205**. The load carrying portion **76** of the flexible belt **70** is located a second distance from the bottoms **20**, **30** of the first and second frame elements **12**, **22**. With the platform **205** mounted in the lift-table-receiving space **60** of the conveyor **10**, the combined height of the lift table **204** and the conveyor **10** mounted thereon is less than or equal to the first distance. In this manner, the load carrying portion **76** of the flexible belt **70** of the conveyor **10** can be aligned with the load carrying surface **218** of the adjacent conveyor **206** to allow objects and/or stacks of objects to be transferred back and forth between the conveyor **10** and the adjacent conveyor **206** without the need for a pit **208**.

A method according to an embodiment of the present invention is illustrated in FIG. **14** and includes a step **120** of providing a planar support surface, a step **122** of providing a first conveyor having a load carrying surface, and a step **124** of placing the first conveyor on the support surface such that the load carrying surface is located a first distance from the planar support surface. The method also includes a step **126** of providing a lift table shiftable between a lowered configuration and a raised configuration, the lift table in the lowered configuration having a first height, and a step **128** of placing the lift table adjacent to the first conveyor on the planar support surface. The method further comprises a step **130** of providing a second conveyor having a bottom and a load carrying surface and a lift-table receiving opening, the second conveyor load carrying surface being spaced from the bottom by a second distance, a sum of the first height and the second distance being greater than the first distance, a step **132** of placing the second conveyor on the lift table with a portion of the lift table in the lift-table-receiving opening so that a second height, from the planar support surface to the second conveyor load carrying surface, is less than the sum of the first height and the second distance and a step **134** of transferring an article from the second conveyor to the first conveyor.

The present invention has been described herein in terms of one or more presently preferred embodiments. Modifications and additions to these embodiments will become apparent to those of ordinary skill in the art upon a reading of the foregoing description. It is intended that all such modifications and additions form a part of the present application to the extent they fall within the scope of the several claims appended hereto.

We claim:

1. A conveyor comprising a frame having first and second spaced frame elements having outer sides and facing inner sides, first and second drive rollers between the first and second frame elements, a flexible belt mounted on the first and second drive rollers, first and second drive wheels connected to the first and second drive rollers, and a drive on the outer side of the first frame element and operably connected to the first and second drive wheels and configured to drive the belt in a first direction and in a second direction opposite the first direction.

2. The conveyor of claim **1**, wherein the first drive wheel is coaxially mounted on the first drive roller.

3. The conveyor of claim **1**, wherein the first drive wheel is mounted on the outer side of the first frame element.

4. The conveyor of claim **1**, wherein the conveyor comprises a first end portion including the first drive roller, a second end portion including the second drive roller and a central portion including a midpoint between the first drive roller and the second drive roller, wherein the belt includes a load carrying portion and a return portion, and wherein a largest spacing between the load carrying portion and the return portion occurs outside said central portion.

5. The conveyor of claim **1**, wherein the drive includes a drive sprocket, the first drive wheel comprises a first sprocket and the second drive wheel comprises a second sprocket, and including a drive chain on the drive sprocket, the first sprocket and the second sprocket.

6. A conveyor comprising a frame having first and second spaced frame elements having outer sides and facing inner sides, first and second drive rollers between the first and second frame elements, a flexible belt mounted on the first and second drive rollers, first and second drive wheels connected to the first and second drive rollers, and a drive operably connected to the first and second drive wheels and con-

figured to drive the belt in a first direction and in a second direction opposite the first direction,

wherein the drive includes a drive sprocket, the first drive wheel comprises a first sprocket and the second drive wheel comprises a second sprocket, and including a drive chain on the drive sprocket, the first sprocket and the second sprocket.

7. The conveyor of claim **6**, wherein the drive is mounted to the outer side of the first frame element.

8. The conveyor of claim **6**, wherein the first drive wheel and the drive chain are located on the outer side of the first frame element.

9. The conveyor of claim **6**, wherein the first drive wheel and the second drive wheel are mounted on the first frame element.

10. The conveyor of claim **9**, including at least one tensioning sprocket mounted on the first frame element, wherein the drive chain is mounted on the tensioning sprocket.

11. A conveyor comprising:

a frame having first and second spaced frame elements having outer sides and facing inner sides;

a first drive shaft having a first end supported by the first frame element and a second end supported by the second frame element;

a second drive shaft having a first end supported by the first frame element and a second end supported by the second frame element;

a flexible belt supported on the first and second drive shafts,

a drive belt or chain operably connected to the first drive shaft for driving the first drive shaft, the drive belt or chain also being operably connected to the second drive shaft for driving the second drive shaft; and

a drive mounted on the outer side of the first frame element, the drive being operably connected to the drive belt or chain and configured to drive the drive belt or chain in a first direction and in a second direction opposite the first direction.

12. The conveyor of claim **11**, further including:

a first drive element on the first drive shaft;

a second drive element on the second drive shaft;

wherein the drive belt or chain is connected to the drive and to the first drive element and to the second drive element.

13. The conveyor of claim **12**, wherein the first drive shaft includes a first portion between the first and second spaced frame elements and a second portion outside the first and second frame elements and wherein the second drive shaft includes a first portion between the first and second spaced frame elements and a second portion outside the first and second frame elements and wherein the first drive element is mounted on the second portion of the first drive shaft and the second drive element is mounted on the second portion of the second drive shaft.

14. The conveyor of claim **13**, wherein the drive belt or chain comprises a drive chain and the first drive element comprises a first drive sprocket and the second drive element comprises a second drive sprocket.

15. The conveyor of claim **13**, wherein the drive belt or chain comprises a drive belt and the first drive element comprises a first flanged wheel and the second drive element comprises a second flanged wheel.

16. The conveyor of claim **12**, wherein the drive belt or chain is supported by the first drive element and by the second drive element.

17. The conveyor of claim **11**, wherein the drive is mounted on the first frame element on the outer side of the first frame element.

18. The conveyor of claim **11**, wherein the drive comprise an output shaft, wherein the drive belt or chain comprises a closed loop and wherein at least a portion of the output shaft, at least a portion of the first drive shaft and at least a portion of the second drive shaft are inside the closed loop.

19. The conveyor of claim **11**, including first and second tensioning wheels on the outside of the first frame element configured to tension the drive belt or chain.

20. The conveyor of claim **11**, wherein the drive includes a drive sprocket, the first drive wheel comprises a first sprocket and the second drive wheel comprises a second sprocket, and including a drive chain on the drive sprocket, the first sprocket and the second sprocket.

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